

**PetroChem**  
Inspection Services

1475 EAST SAM HOUSTON PARKWAY SOUTH  
SUITE 100  
PASADENA, TEXAS 77503  
(281) 884-5100

**HYDROSTATIC SETTLEMENT  
TANK INSPECTION REPORT  
FOR  
SUPERIOR CRUDE GATHERING  
TANK 15  
FALCON REFINERY  
INGLESIDE, TEXAS  
MAY 5-24, 2010**

## INTRODUCTION

Welfab, Inc., contracted with TÜV SÜD PetroChem Inspection Services, to provide inspection services for Tank 15.

This report documents the findings and provides an evaluation of the inspection results per the applicable criteria of API Standard 653.

TÜV SÜD PetroChem Inspection Services personnel:

Joe B. Fleck  
API 653 Aboveground Storage Tank Inspector  
Certification 23836

George Yee  
API 653 Aboveground Storage Tank Inspector  
Certification 31090

Kerwin Kjelstrom  
Assistant

## **SUITABILITY FOR SERVICE**

Tank 15 was hydrostatically tested for the 24 hour minimum at 35.75 ft and is suitable for service according to the applicable criteria of API Standard 653 if the safe fill height recommendations of this report are adhered to.

---

Mark Baker, Ohio P.E. #71514

Date

## **TABLE OF CONTENTS**

---


<b>1. TANK DESCRIPTION .....</b>	<b>5</b>
<b>2. INSPECTION REPORT .....</b>	<b>6</b>
2.1 FOUNDATION INSPECTION (AT EMPTY) .....	7
2.1.1 FOUNDATION SETTLEMENT EVALUATION .....	8
2.1.2 FOUNDATION SETTLEMENT SURVEY TABLE .....	9
2.2 FOUNDATION INSPECTION (AT HALF FULL) .....	10
2.2.1 FOUNDATION SETTLEMENT EVALUATION .....	11
2.2.2 FOUNDATION SETTLEMENT SURVEY TABLE .....	12
2.3 FOUNDATION INSPECTION (AT FULL) .....	13
2.3.1 FOUNDATION SETTLEMENT EVALUATION .....	14
2.3.2 FOUNDATION SETTLEMENT SURVEY TABLE .....	15
<b>3. SHELL INSPECTION .....</b>	<b>16</b>
3.1 SHELL THICKNESS CALCULATIONS .....	17
<b>4. EQUIPMENT .....</b>	<b>18</b>
4.1 LEVEL .....	18
<b>5. WARRANTY .....</b>	<b>19</b>

API 653 Inspection Report	 <b>PetroChem</b> Inspection Services	Out-of-Service
---------------------------	---	----------------

Owner: Superior Crude Gathering	Date: May 5-24, 2010
Location: Ingleside, Texas	Page: 5 of 19
Tank: 15	Project No.: 722804571

## 1. TANK DESCRIPTION


GENERAL:	
TANK NUMBER:	15
OWNER:	Superior Crude Gathering
DESIGN STD:	API 650
TANK LOCATION:	Ingleside, Texas
SITE:	Falcon Refinery
MANUFACTURER:	Baker Tank Company
PRODUCT:	Crude Oil
NORMAL OPER. TEMP.:	Ambient
CATHODIC PROT.:	No
NAMEPLATE PRESENT:	Yes
DIMENSIONS:	
DIAMETER:	100.00 ft
HEIGHT:	39.67 ft (After Second Bottom Installation)
FILLING HEIGHT:	35.42 ft (per Client)
NOMINAL CAPACITY:	55,000 bbls (per Nameplate)
GEOMETRY:	
FOUNDATION:	Concrete Ringwall
BOTTOM:	Lap Welded (Second Bottom Installed 2010)
SHELL:	Butt Welded
FIXED ROOF:	Lap Welded Cone w/ Framing
FLOATING ROOF:	Aluminum Pontoon
PRIMARY SEAL:	Foam Wiper
SECONDARY SEAL:	None
DATES:	
YEAR BUILT:	1977
LAST INSPECTION:	Data Not Available
ACCESS:	
FIXED ROOF:	Spiral Stairway
FLOATING ROOF:	N/A - No access during inspection
COATINGS:	
BOTTOM:	None
SHELL:	External - Silver Paint
FIXED ROOF:	External - White Paint
FLOATING ROOF:	None

<b>API 653 Inspection Report</b>			<b>PetroChem</b> Inspection Services	<b>Out-of-Service</b>
Owner: Superior Crude Gathering		Date: May 5-24, 2010		
Location: Ingleside, Texas		Page: 6 of 19		
Tank: 15		Project No.: 722804571		

## 2. INSPECTION REPORT

### SUMMARY

Tank 15 was repaired and a second bottom installed 4 inches above the original bottom. A hydrostatic test was performed. The settlement surveys were performed at empty, half-full, and at full. There were no leaks after the tank was held at full for 24 hours.

API 653 Inspection Report		 <b>PetroChem</b> Inspection Services	Out-of-Service
Owner: Superior Crude Gathering		Date: May 5-24, 2010	
Location: Ingleside, Texas		Page: 7 of 19	
Tank: 15		Project No.: 722804571	

## 2.1 FOUNDATION INSPECTION (AT EMPTY)

The survey found the tank to be out of level by 1.80 inches. API 653 calculation for deflection of this tank is 0.94 inch. API 653 maximum deflection permitted for this tank is calculated to be 1.63 inches. Differential settlement calculations for this tank do not exceed the API allowable (ref. API 653, Appendix B, Para. B.3.2).

Owner: Superior Crude Gathering

Date: May 5-24, 2010

Location: Ingleside, Texas

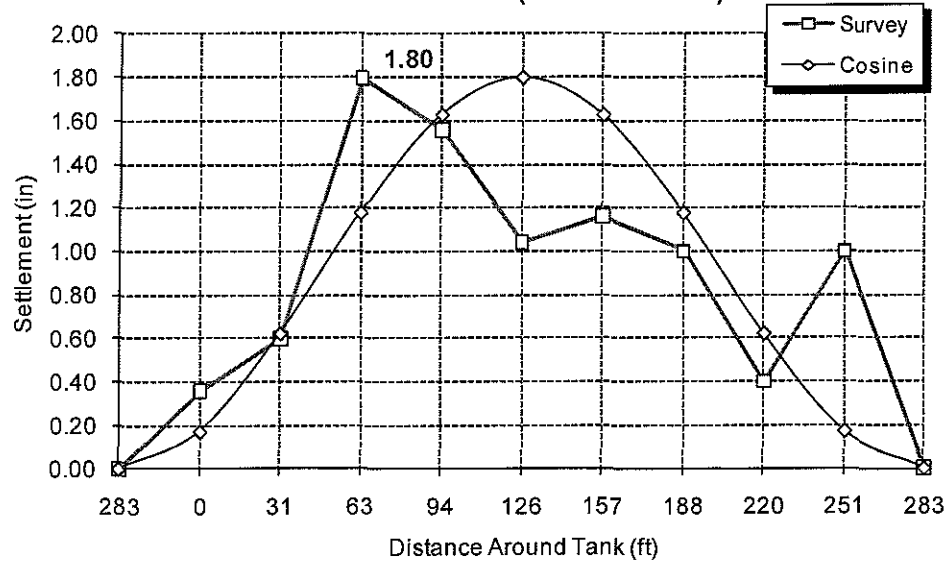
Page: 8 of 19

Tank: 15

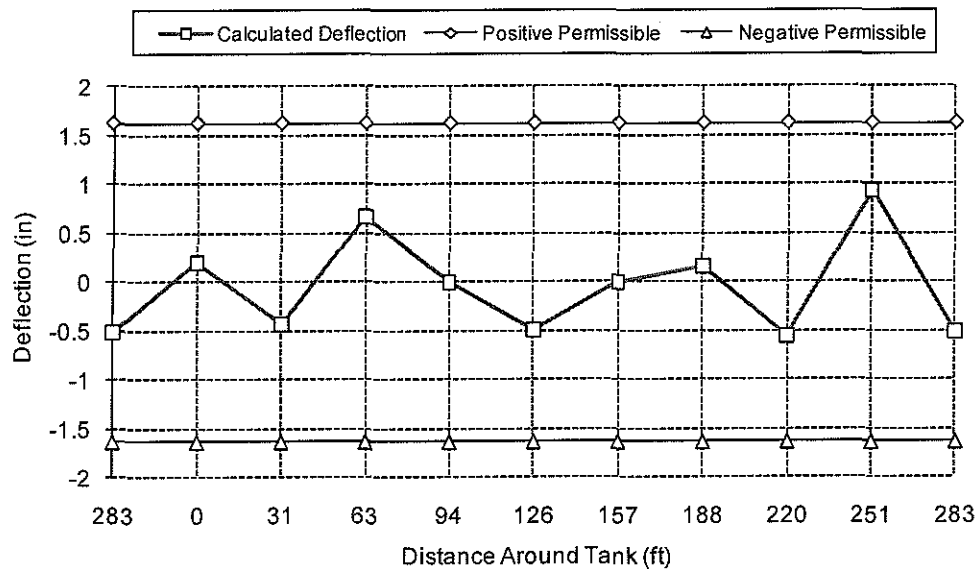
Project No.: 722804571

## 2.1.1 FOUNDATION SETTLEMENT EVALUATION

Shell Settlement (Survey Data)  
 Vs.  
 Planar Settlement (Cosine Curve)



## Differential Settlement Evaluation







Owner: Superior Crude Gathering

Date: May 5-24, 2010

Location: Ingleside, Texas

Page: 9 of 19

Tank: 15

Project No.: 722804571

## 2.1.2 FOUNDATION SETTLEMENT SURVEY TABLE

The survey was conducted counterclockwise from the reference Shell Manway A located at Station 0.0. The circumferential distance between the readings is 31.40 feet.

Point No.	Shell Settlement Reading (ft.)
1	3.400
2	3.420
3	3.520
4	3.500
5	3.457
6	3.467
7	3.453
8	3.403
9	3.453
10	3.370



Owner: Superior Crude Gathering	Date: May 5-24, 2010
Location: Ingleside, Texas	Page: 10 of 19
Tank: 15	Project No.: 722804571

## 2.2 FOUNDATION INSPECTION (AT HALF-FULL)

The survey found the tank to be out of level by 0.60 inch. API 653 calculation for deflection of this tank is 0.49 inch. API 653 maximum deflection permitted for this tank is calculated to be 1.63 inches. Differential settlement calculations for this tank do not exceed the API allowable (ref. API 653, Appendix B, Para. B.3.2).

Owner: Superior Crude Gathering

Date: May 5-24, 2010

Location: Ingleside, Texas

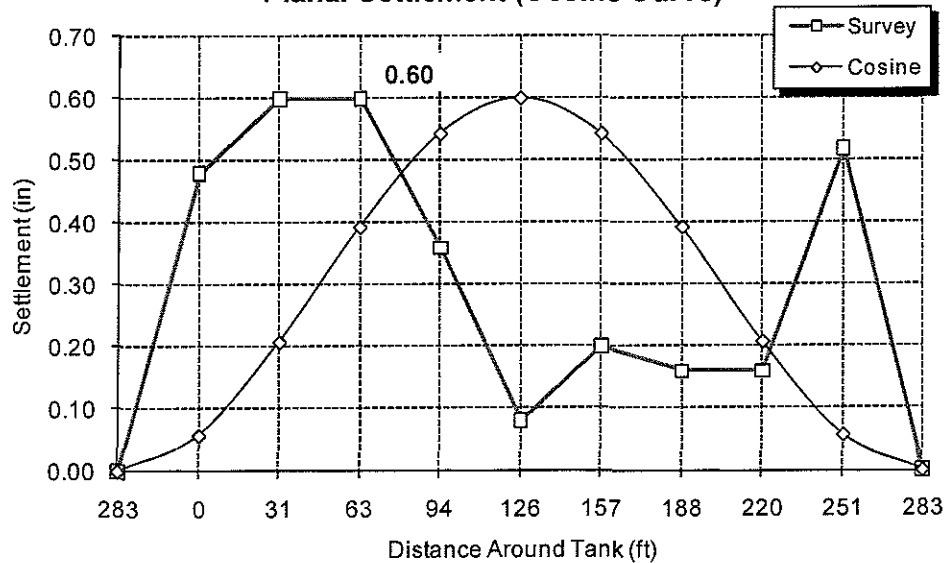
Page: 11 of 19

Tank: 15

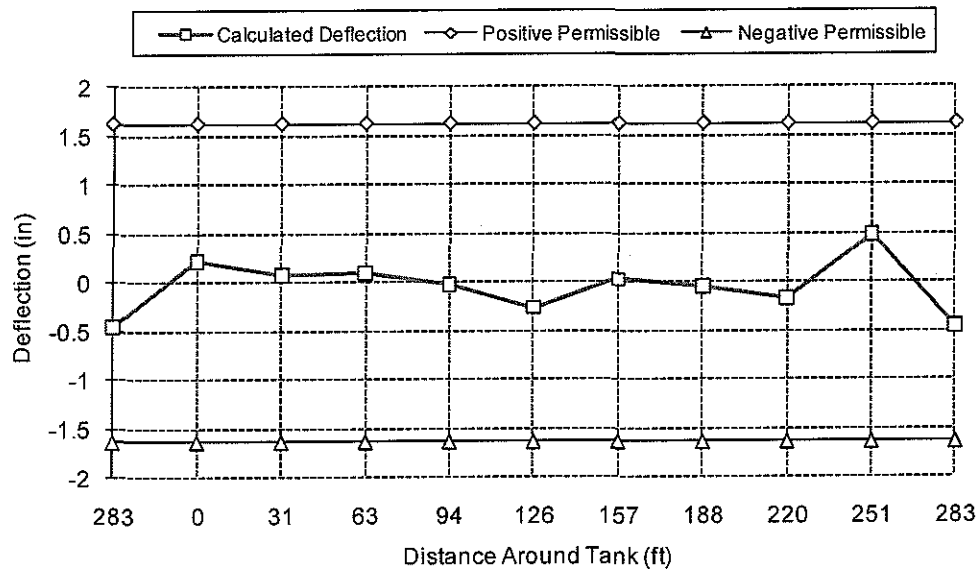
Project No.: 722804571

## 2.2.1 FOUNDATION SETTLEMENT EVALUATION

Shell Settlement (Survey Data)  
Vs.  
Planar Settlement (Cosine Curve)



## Differential Settlement Evaluation





Owner: Superior Crude Gathering

Date: May 5-24, 2010

Location: Ingleside, Texas

Page: 12 of 19

Tank: 15

Project No.: 722804571

## 2.2.2 FOUNDATION SETTLEMENT SURVEY TABLE

The survey was conducted counterclockwise from the reference Shell Manway A located at Station 0.0. The circumferential distance between the readings is 31.40 feet.

Point No.	Shell Settlement Reading (ft.)
1	3.020
2	3.030
3	3.030
4	3.010
5	2.987
6	2.997
7	2.993
8	2.993
9	3.023
10	2.980

Owner: Superior Crude Gathering	Date: May 5-24, 2010
Location: Ingleside, Texas	Page: 13 of 19
Tank: 15	Project No.: 722804571

## 2.3 FOUNDATION INSPECTION (AT FULL)

The survey found the tank to be out of level by 1.64 inches. API 653 calculation for deflection of this tank is 0.47 inch. API 653 maximum deflection permitted for this tank is calculated to be 1.63 inches. Differential settlement calculations for this tank do not exceed the API allowable (ref. API 653, Appendix B, Para. B.3.2).

Owner: Superior Crude Gathering

Date: May 5-24, 2010

Location: Ingleside, Texas

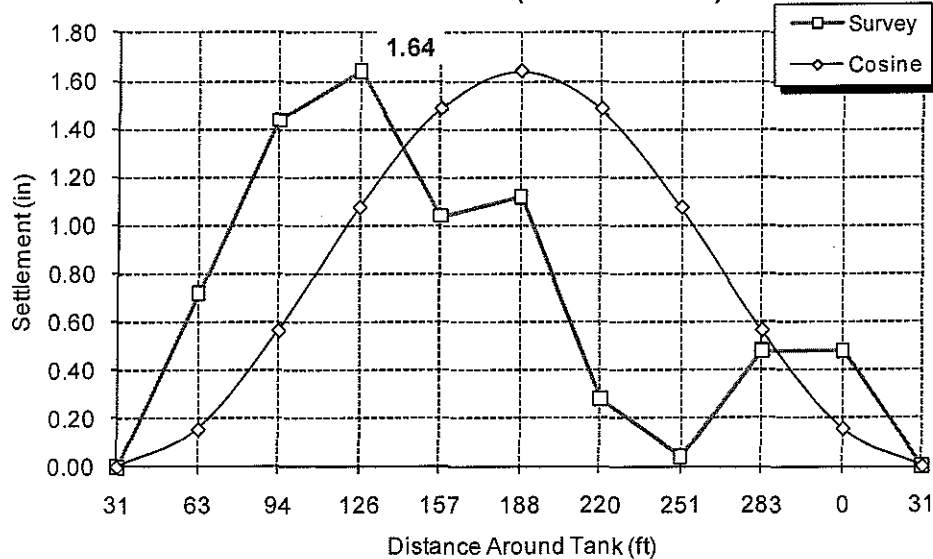
Page: 14 of 19

Tank: 15

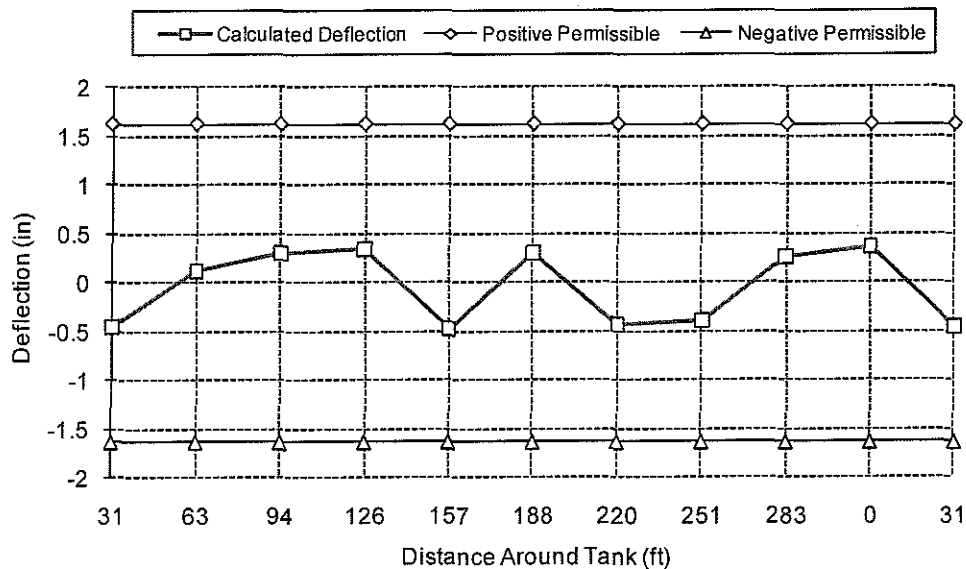
Project No.: 722804571

## 2.3.1 FOUNDATION SETTLEMENT EVALUATION

Shell Settlement (Survey Data)  
Vs.  
Planar Settlement (Cosine Curve)



## Differential Settlement Evaluation





Owner: Superior Crude Gathering

Date: May 5-24, 2010

Location: Ingleside, Texas

Page: 15 of 19

Tank: 15

Project No.: 722804571

### 2.3.2 FOUNDATION SETTLEMENT SURVEY TABLE

The survey was conducted counterclockwise from the reference Shell Manway A located at Station 0.0. The circumferential distance between the readings is 31.40 feet.

Point No.	Shell Settlement Reading (ft.)
1	4.390
2	4.350
3	4.410
4	4.470
5	4.487
6	4.437
7	4.443
8	4.373
9	4.353
10	4.390

Owner: Superior Crude Gathering	Date: May 5-24, 2010
Location: Ingleside, Texas	Page: 16 of 19
Tank: 15	Project No.: 722804571

### 3. SHELL INSPECTION

Shell thickness calculations indicate the safe fill height of 39.67 feet can be utilized with product specific gravities up to 0.87. The storage of product with specific gravities between 0.87 and 1.00 should be restricted to between 39.67 and 35.55 feet, respectively (ref. API 653, Para. 4.3.3.1). These calculations do not take into account operational restrictions imposed by such items as any internal or external floating roof, internal pressure, overflow vents, etc.





Owner: Superior Crude Gathering

Date: May 5-24, 2010

Location: Ingleside, Texas

Page: 17 of 19

Tank: 15

Project No.: 722804571

### 3.1 SHELL THICKNESS CALCULATIONS

The minimum acceptable shell plate thickness for tanks with a diameter equal to or less than 200 feet is calculated as follows (API 653, Para. 4.3.3.1):

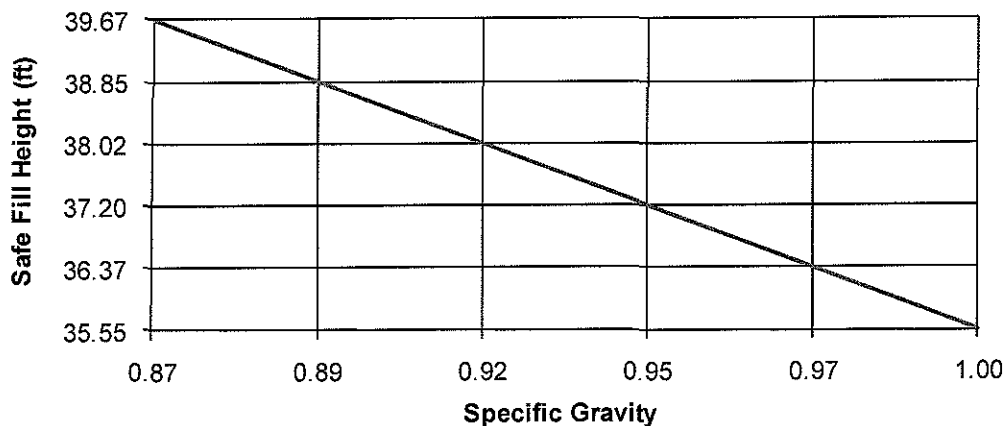
$$t_{\min} = \frac{2.6(H-1)DG}{SE}$$

**Where:**

**S** = See Table = Allowable Stress (psi)  
**D** = 100.00 = Nominal Diameter of Tank (ft.)  
**G** = 0.87 = Highest Specific Gravity of Contents  
**H** = See Table = Product Height (ft.)  
**E** = See Table = Joint Efficiency

Course	Course Height (ft.)	Product Height (ft.)	Joint Efficiency	Allowable Stress (psi)	Average Thickness (in.)	Required Thickness (in.)	Meets Required Thickness
1	7.63	39.67	0.85	23,600	0.515	0.435	Y
2	7.96	32.05	0.85	23,600	0.349	0.349	N
3	7.96	24.09	0.85	26,000	0.252	0.236	Y
4	7.96	16.13	0.85	26,000	0.257	0.154	Y
5	8.17	8.17	0.85	26,000	0.257	0.100	Y

**Safe Fill Height  
Vs.  
Specific Gravity**





Owner: Superior Crude Gathering	Date: May 5-24, 2010
Location: Ingleside, Texas	Page: 18 of 19
Tank: 15	Project No.: 722804571

## 4. EQUIPMENT

### 4.1 LEVEL

TYPE	MODEL
Self-Leveling Laser	Acculine Pro 40-6515

## 5. WARRANTY

TÜV SÜD PetroChem Inspection Services, Inc. ("Company") has performed inspection services on equipment designated by Superior Crude Gathering (owner/operator) and has evaluated its condition based on observations and measurements made by Company's inspectors. While our evaluation accurately describes the condition of the equipment at the time of inspection, the owner/operator must independently assess the inspection information/report provided by Company and any conclusions reached by owner/operator and any action taken or omitted to be taken are the sole responsibility of the owner/operator. With respect to inspection and testing, Company warrants only that the services have been performed in accordance with accepted industry practice. If any such services fail to meet the foregoing warranty, Company shall re-perform the service to the same extent and on the same conditions as the original service.

Company makes no warranty, express or implied, with regard to goods or services provided by Company other than those warranties set forth herein. The preceding paragraph sets forth the exclusive remedy for claims based on failure or of defect in materials or services, whether such claim is made in contract or tort (including negligence) and however instituted, and, upon expiration of the warranty period, all such liability shall terminate. The foregoing warranty is exclusive and in lieu of all other warranties, whether written, oral, implied or statutory. NO IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE SHALL APPLY, nor shall Company be liable for any loss or damage whatsoever by reason of its failure to discover, report, repair or modify latent defects or defects inherent in the design of any equipment inspected. In no event, whether a result of breach of contract, warranty or tort (including negligence) shall Company be liable for any consequential or incidental damages including, but not limited to, loss of profit or revenues, loss of use of equipment tested or services by Company or any associated damage to facilities, down-time costs or claims of other damages.